January 20, 2012

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Office of the Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Room TW-A 325
Washington, D.C. 20554

Re: ET Docket No. 11-90; RM-11555; ET Docket No. 10-28; ***EX PARTE***

Dear Ms. Dortch:

Toyota Motor North America, on behalf of Toyota Motor Corporation (TMC), hereby submits "EX PARTE COMMENTS" regarding the above-referenced proceedings.

If you have any inquiries or correspondence concerning this matter, please feel free to contact me at 202-463-6831, or my staff, Ms. Megumi Suzuki, at 202-463-6821.

Sincerely,

Kevin Ro
Director
Technical and Regulatory Affairs
Toyota Motor North America, Inc.

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
	)	ET Docket No. 11-90
Amendment of Sections 15.35 and 15.253 of	)	RM-11555
the Commission's Rules Regarding Operation	)	
of Radar Systems in the 76.0-77.0 GHz Band.	)	
	)	
Amendment of Section 15.253 of the	)	
Commission's Rules to Permit Fixed Use of	)	ET Docket No. 10-28
Radar in the 76-77 GHz Band.	)	

EX PARTE COMMENTS OF THE

TOYOTA MOTOR CORPORATION

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Kevin S. Ro
Director
Technical & Regulatory Affairs
Safety

Submitted: January 20, 2012

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SUMMARY

Pursuant to Section 1.405 of the Federal Communications Commission's (FCC's) Rules,[1] Toyota Motor North America, Inc. (TMA), on behalf of Toyota Motor Corporation (TMC) hereby submits comments in response to additional points raised in these proceedings by the National Academy Sciences' National Research Council Committee on Radio Frequencies (CORF).[2] TMC's technical analysis, which is based on real-world considerations and assumptions described by CORF,[3] shows that there would be no electromagnetic interference associated with Toyota's proposed vehicular radar

[1] 47 C.F.R. §1.405.
[2] *See* Comments of the National Academy of Sciences' Committee on Radio Frequencies, ET Docket Nos. 11-90, 10-28 (filed August 8, 2011) ("CORF Comments").
[3] CORF Comments at 9.

operations at 77 GHz that would impede radio astronomy facilities. Moreover, Toyota has introduced approximately 300,000 vehicles equipped with 76-77 GHz millimeter wave radar devices into the global market that operate by emitting radio waves while the vehicles are not in motion, and has not received any report thus far with regard to interference to radio astronomy observations.

Therefore, TMC respectfully renews its call for the Commission to implement TMC's proposal in this proceeding to modify the Section 15.253 emission limits as proposed in the Notice;[4] to eliminate the "not-in-motion" criteria; and to defer action on the Commission's proposal for fixed use of the 76-77 GHz band to a future proceeding. Such action will further advance safety and convenience of the public by promoting new technology in the United States market.

BACKGROUND

Increasing global awareness of vehicular safety has resulted in growing numbers of vehicles with safety assistance systems that use 76-77 GHz millimeter wave collision-avoidance radar devices. Current U.S. regulations specify different power density limits for each of the following cases: for forward looking radars when the vehicle is in motion; for side and rear looking radars when the vehicle is in motion; and for radars when the vehicle is not in motion.

The automotive industry has proposed that the Federal Communications Commission unify these limits, and, in response, the Commission issued a Notice of

[4] *Amendment of Section 15.35 and 15.253 of the Commission's Rules regarding Operation of radar Systems in the 76-77 GHz Band*, Notice of Proposed Rulemaking, 26 FCC Rcd 8107 (2011).

Proposed Rule Making that would eliminate the distinction between "in motion" and "not in motion" radar emissions.[5]

Subsequently, the National Research Council's Committee on Radio Frequencies (CORF) submitted comments to the Commission expressing its concern over the potential for interference to radio astronomy operations from vehicular radar emissions. Toyota has already explained why the concerns of the radio astronomy community are unfounded,[6] and the Strategic Automotive Radar Frequency Allocation Group ("SARA") recently filed comments in concurrence with TMC's position in this proceeding.[7] Toyota would like to respond to issues raised by CORF, specifically referencing the calculations provided in Appendix B of the CORF comments.[8]

REVIEW OF CORF CALCULATIONS

In its comments, CORF provided calculations to predict interference to radio astronomy from vehicular radar transmitters. CORF's calculations were based on an example using 50 vehicle-mounted millimeter wave radars operating at a distance of 10 km from a radio astronomy antenna. A radiating power of -3dBm/MHz (a value obtained from ECC report 56)[9] is applied in the calculation [1]. The attenuation of a millimeter

[5] *Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band, ET Docket No. 11–90, RM-11555, Amendment of Section 15.253 of the Commission's Rules to Permit Fixed Use of Radar in the 76-77 GHz Band, ET Docket No. 10–28, Notice of Proposed Rulemaking, 26 FCC Rcd 8107 (2011) ("NPRM").*
[6] *See* Ex Parte filing by TMC, ET Docket Nos. 11-90, 10-28 (filed Sept. 22, 2011) and Reply Comments of TMC, ET Docket Nos. 11-90, 10-28 (filed August 1, 2011). *See also* Comments of the TMC (filed July 18, 2011) and TMC Reply Comments, RM-11555 (filed Oct. 8, 2009).
[7] *See* Comments of SARA, ET Docket Nos. 11-90, 10-28 (filed Jan. 3, 2012).
[8] CORF Comments at 9.
[9] *See* Reference 1.

wave before reaching a radio astronomy antenna is expressed by the following equation [2]:

$$\Gamma = 20\log\left(\frac{4\pi d}{\lambda}\right) + 0.000135d$$

In this equation, Γ represents radio wave attenuation, λ represents wavelength of the radio signal and *d* represents the distance between the millimeter wave radar and the radio astronomy antenna. The first term in the equation represents radio wave attenuation in free space, and the second term represents the atmospheric attenuation. The value of the atmospheric attenuation is taken from the value used in the CORF comment. Accordingly, the spectral power flux density (spfd) is calculated by the following formula:

$$spfd = p + 10\log(N) - \Gamma - 10\log\left(\frac{\lambda^2}{4\pi}\right)$$

In this formula, p[dBW Hz-1] is the power emitted from the radar, and N is the number of vehicles equipped with the radars. By simple calculation applying the reduction formula, the power radiated to the radio telescope becomes -168dBW m-2 Hz-1. Since the system sensitivity of radio astronomy set in ITU-R RA 769-2 is -208dBW m-2 Hz-1, CORF argues that 40 dB attenuation is necessary for radio wave power radiated from a radar. It maintains that if this alleged interference is not accounted for by the Commission

in amending the rule, there may be impacts on the operation of radio astronomy observations. We believe that CORF's calculations are inaccurate in that they fail to account for other factors that are necessary for the accurate prediction of interference effects. These factors are explained below.

INTERFERENCE TO RADIO ASTRONOMY

The great sensitivity of radio telescopes is achieved by not only using huge antennas but also by integrating observed data for noise reduction. According to ITU-R RA. 769-2, the sensitivity can be calculated by the following equation:

$$\frac{\Delta P}{P} = \frac{1}{\sqrt{\Delta f_0 t}}$$

Applying a bandwidth (Df) of 1 MHz and a time (t) of 2,000 seconds criteria which are defined in ITU-R RA.769-2 as conditions for radio astronomy, the noise reduction effect would be as much as -46dB. Since radar waves are scattered by environmental factors such as ground, trees, and buildings, and manifest as noise through radio telescopes, this reduction effect also applies to radar waves. In other words, for the estimation of interference between millimeter wave radars and radio astronomy, this reduction effect should be included in the calculation in addition to the power radiated to

radio astronomy observations as calculated in the previous section.[10] Taking this reduction effect into consideration, the calculated spfd becomes -214dBW m-2 Hz-1. This figure is 6 dB lower than the system sensitivity of radio astronomy, -208 dBW m-2 Hz-1. A margin of 0.1 times is already included in the system sensitivity used in this calculation.

Thus, accounting for the noise, the losses caused by trees or urban structures that occur in actual situations, the power delivered to radio astronomy observations is significantly reduced due to these losses, and attenuated to a level such that the power does not impose any problem for the operation of radio astronomy observations.

CONCLUSION

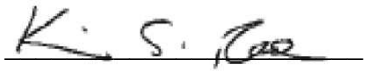
As mentioned, Toyota has produced approximately 300,000 vehicles with 76-77 GHz millimeter wave radar devices for approximately 10 years in the global market. In most countries, radio waves are emitted even when the vehicle is not in motion, and we do not have any existing reports that interference to radio astronomy has occurred. We believe this fact supports the above analysis. In Europe and Japan, many roads are within several kilometers of radio astronomy facilities which use the same bandwidth (76-77 GHz band) (see the Appendix), and there have been no reports of interference occurring to radio astronomy.

If situations actually exist such as those described by CORF, then there should have been cases of interference already occurring and reported, however, Toyota is aware of no such case. Toyota believes that the adoption by the Commission of the proposed

[10] *See* Reference 4.

limits will not cause any impact to radio astronomy with respect to electromagnetic interference, and we are confident that both of these technologies will be able to coexist after the proposed limits are adopted by the Commission. These new limits will promote convenience and safety of society without hampering the progress of science and technology.

Respectfully submitted,



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REFERENCE

[1] Electronic Communications Committee (ECC), within The European Conference of Postal and Telecommunications Administrations (CEPT), ECC REPORT 56, "Compatibility of Automotive Collision Warning Short Range Radar Operating at 79 GHz with Radiocommunication Services" Stockholm, Sweden, October 2004.

[2] Rec. ITU-R P.525-2, "CALCULATION OF FREE-SPACE ATTENUATION", 1978-1982-1994.

[3] Rec. ITU-R RA.769-2, " Protection criteria used for radio astronomical measurements ", 1992-1995-2003.

[4] EuRAD08-4, "Reduced Interference of 79GHz UWB Automotive Radars to Radio Astronomy Stations by Signal Integration Effects", H. Kondoh, K. Sato, T. Horimatsu, S. Oyama.

APPENDIX

Below are examples that describe locations of radio telescopes in several countries that have a close proximity (1.5 km~) to major roads. It should be noted that these countries allow 76-77 GHz millimeter wave radars to emit radio waves while the vehicle is in motion. As noted in the comment, there have been no electromagnetic interference problems reported for operating radio astronomy observatories.

1. Sardinia Radio Telescope (Italy)
   Frequency range : 400MHz – 100GHz

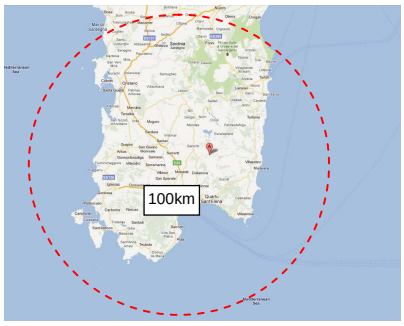

Figure 1. Map 1 of Sardinia Radio Telescope Area

Figure 2. Map 2 of Sardinia Radio Telescope Area

2. Nobeyama Radio Observatory (Japan)
   Frequency range: 10GHz – 230GHz

Figure 3. Map 1 of Nobeyama Radio Observatory

Figure 4. Map 2 of Nobeyama Radio Observatory

3. Radio Telescope Effelsberg (Germany)
   Frequency range: 400MHz – 96GHz

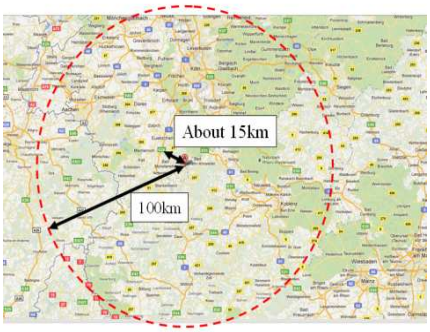

Figure 5. Map 1 of Radio Telescope Effelsberg

Figure 6. Map 2 of Radio Telescope Effelsberg